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# Weaponizing the Spectrum

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by

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# Moving to Net-centric Operations?



DoD "Vision"

*Slow pace of acquisition*

vs

*Warfighter's tempo for improvisation*



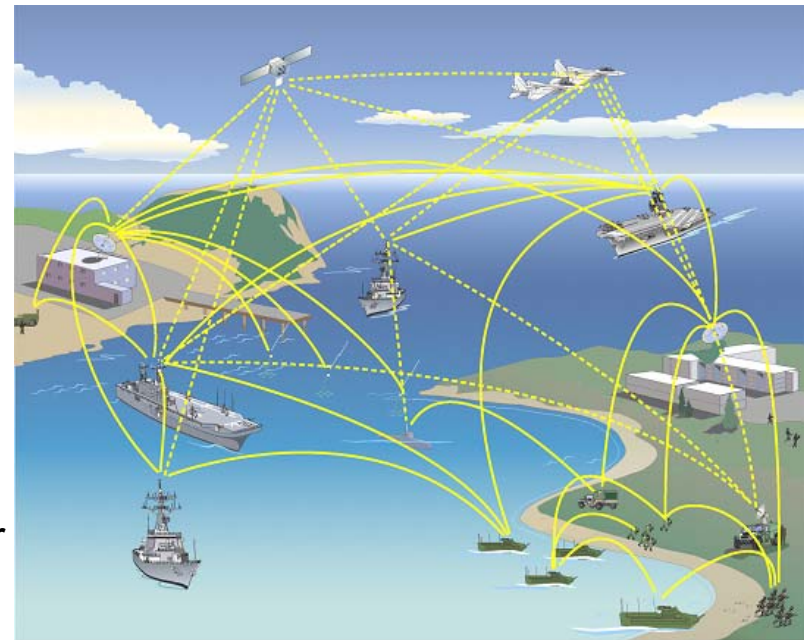
Response

**Opportunity to Transform...  
or just make a bigger version  
of what we've got?**



# Two Parts to Achieve Leap-forward Net-centric Operations Capability

- Distributed, Opportunistic C4ISR Devices and Systems-of Systems
  - Assured communications through redundancy, agility, adaptability, spectrum and bandwidth reuse
  - Net-centric sensing, C3
  - Flat, mesh-like architecture
  - Multifunction C4ISR...
  - Integrated, distributed situational awareness; to the edge
- Next Generation NETOPS and Battle Command at the “Edge”
  - Auto net formation & management - minimize user burden
  - Every PoP is both a source, and a consumer of information
  - Collaborative sensing, comms, fusion and C2... at the local level
  - Multifunctional, distributed behaviors; smart radios and smart protocols



**OUR C4ISR SoS MUST BE FLEXIBLE AND RELIABLE AT THE CORE,  
AND *“IMPROVISABLE”* AT THE EDGE!**

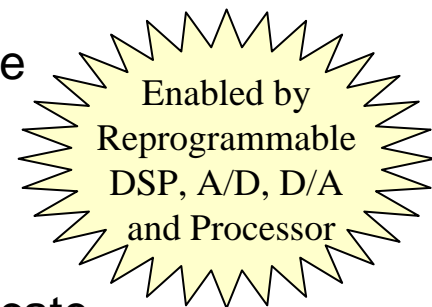


# Disruptive C4ISR Devices and Systems



# Opportunistic Multifunctional Spectrum Access Devices

- Integrated Packages of “Detectors/Transducers” and “Emitters” for Integrated, Multifunction Capability to Provide Comms, Sensing, Targeting, EW, Deception; all Driven by a Common DSP and Computational System
  - Advantages: Weight, Size, Modular Upgrade, Adaptive Flexibility/Survivability
- Operating Principles:
  - Any and All Passive Devices Can Sense or Communicate
  - Any and All Active Devices Can Probe, Communicate or Jam
  - All Devices are Addressable Through Common Air-interface Protocols that Operate in Any Part of the Device’s Range
- Key Technologies: Software Defined Devices; Advanced DSP; Common, Addressable Air-interface Protocols
- Some DARPA Initiatives Illustrate Disruptive Technology Trends
  - WNaN, XG, Wolfpack, Mobile MIMO, etc.





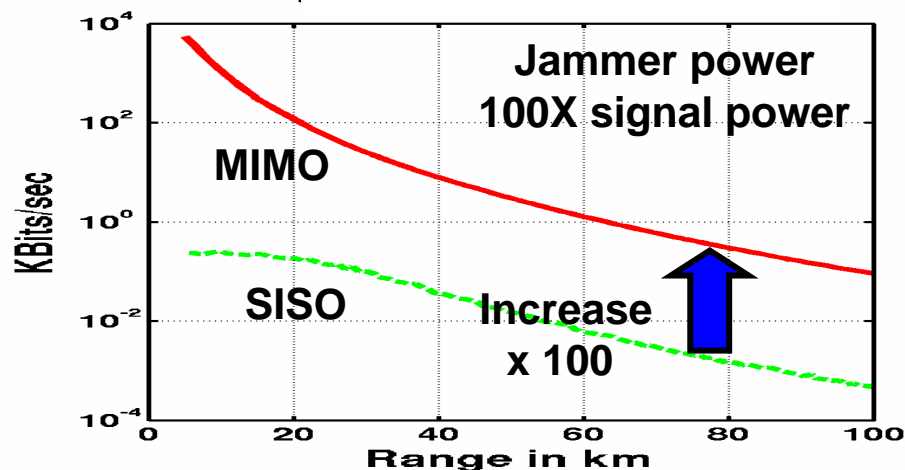
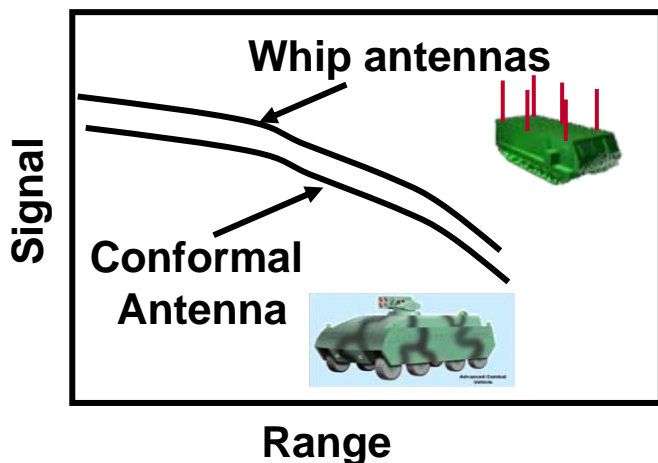
## Functional Power: C4ISR & EW Agility/Redundancy

- Multifunction platforms: Soldiers, manned vehicles, UAVs, UGVs, hand-placed, expendables
  - Common addressable interface to net
  - Reprogrammable DSP-driven functionality
  - Compliance with opportunistic C4ISR design architecture
- Operating principle: Every platform (including the soldier) serves as a communications device, navigation system, relay/router/mobile cell-site, sensor, or EW/spoofing system using any or all detectors and emitters as needs dictate and opportunity allows
- Resource allocation managed by software agents integrated with Battle Command functionality



## Disruptive Technology Device Example: Distributed Adaptive Antenna Element Arrays and MIMO

- Two key technologies:
  - Compact, conformal, affordable, broadband antennas > TRL 6
  - Diversity Processing - distributed elements, separately processed
- Technology focus on MIMO and “diversity processing”
  - Offers 10 to 100-fold increases in data capacity
  - 2 to 3 fold range increases; 20 dB or more AJ margin
  - Significant gains in spectrum efficiency
- MIMO being deployed in commercial wireless operations



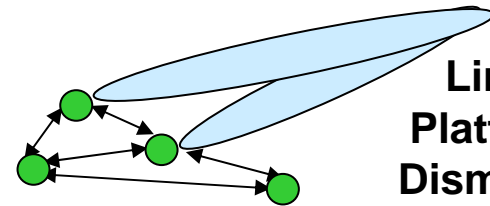




# Disruptive Technology: Antenna Opportunities & Issues

- Vast improvements in performance, capacity
  - Net-centric aperture capability: antenna arrays adaptively configured by addressing elements on single platform, or separate platforms

**Single Platform**



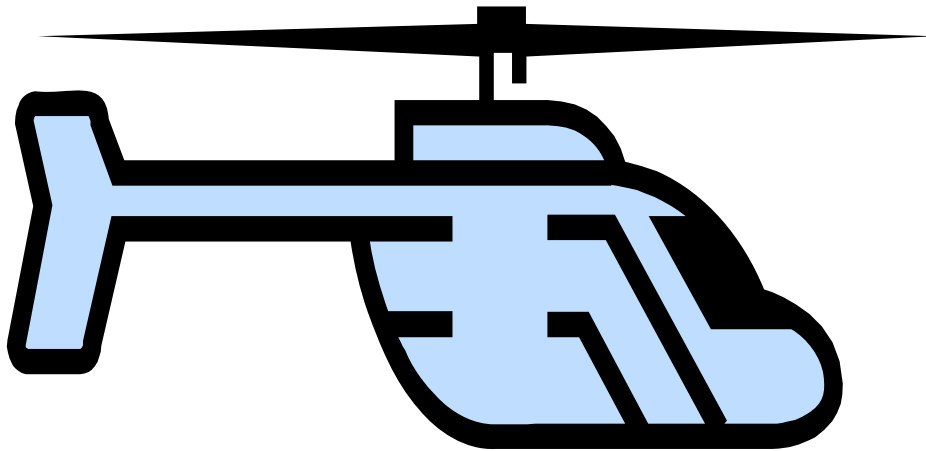
**Linked Platforms, Dismounts, or UGS**

- Eliminates need for certain “dedicated” sensor platforms
- Improved connectivity to dismounts and UGS
- Invest in future: “Design in” element arrays in platforms
  - Leverage future enhancements in DSP and waveforms (“MIMO inside”)
  - Allows growth to multi-function, multi-mode systems
  - Impact on platform; integral antenna elements ... its part of the skin/armor
  - Revolutionary, new capability in tactical C4ISR
  - Requires integral set of protocols (radio, router, antenna control)
  - Common, integrated control for Comms, CID, Intel, EW, Sensors
    - Multi-function protocols and development tools – new technology area?





## Disruptive Technology Device Example: : Sensor/Comms UAV Systems



### Multifunction Sensor/Comms UAV functions

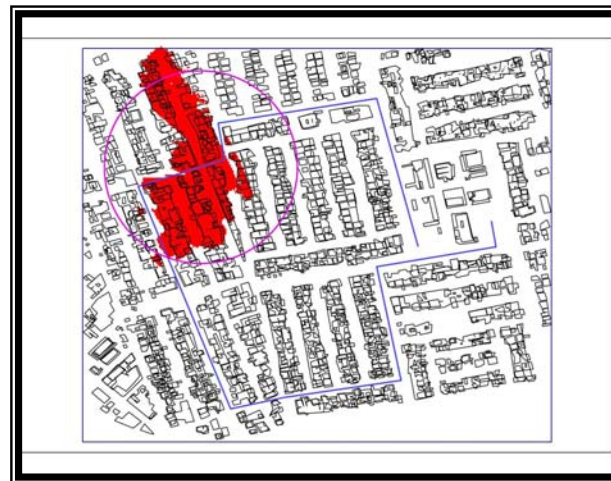
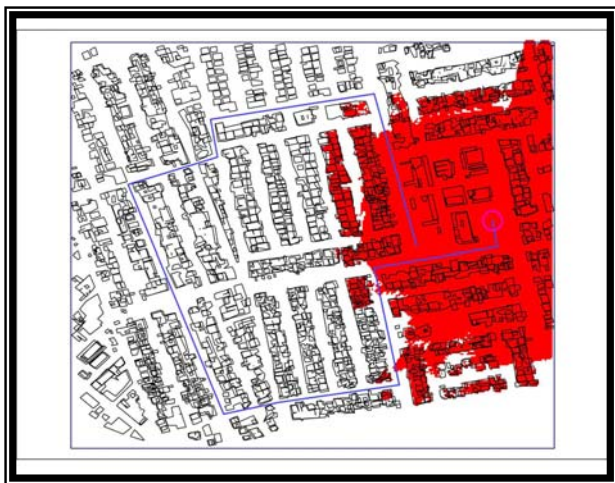
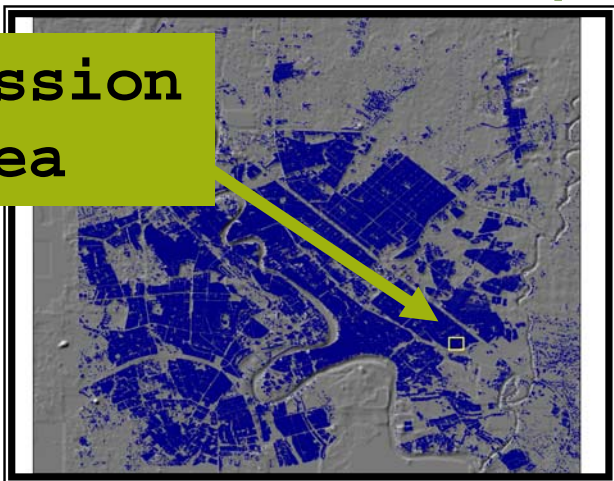
- RF MANET mesh-net node
- Sensor

*Issue: Where do we put it,  
when do we put it there, and  
what do we ask it to do?*



# Tactical RF Planner: Simple to Use; Simple to Understand; Complex Inside

**Mission Area**





# Disruptive NETOPS and Battle Command at the “Edge”



# Net-Centric Ops Battle Command Technology

Provide Net-centric Operations RF management components and dynamic spectrum access software/algorithms to “weaponize the spectrum” and be capable of exploiting critical NETOPS components through Battle Command software.

**Manipulate the Spectrum Resource as a Weapon  
to Gain Advantage**



# C4ISR Resources Integral to Battle Command

- Multifunction C4ISR on every platform should become an integral part of the Battle Command ensemble
  - Creates a multifaceted “Sixth Sense” for Commander SA
  - Provides Commander additional dimensions in Battle Command
    - Multiple source fusion capability on every platform
      - “Am I seeing the same thing as I am hearing, and what do the other vehicles see and hear?”
    - Expanded response options
      - “Do I shoot, or jam, or spoof, .... or go quiet and evade?”
      - “Should I communicate by radio and give away my position, or can I communicate by IR, or laser, or acoustics?”
- Common Battle Command interface to all asset management:
  - Forces, weapons, logistics and communications, sensors, EW, NAVAIDS, info banks



# Advantages

- Provides a structured approach for leveraging our technology to gain significant advantage
  - We are leaders in DSP, SDR and Info Management Technologies
- Provides a vision and theme to rally the transformation of C4ISR
  - Equivalent in scope and ambition to the quest for smart weapons and stealth technology



# Summary

- Multifunctional Devices and Systems Combined with Advanced Battle Command Software Capabilities Provide Opportunity to Exert Opportunistic Control Over the Spectrum.... *We Can Weaponize Spectrum Access*